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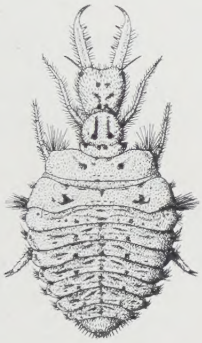

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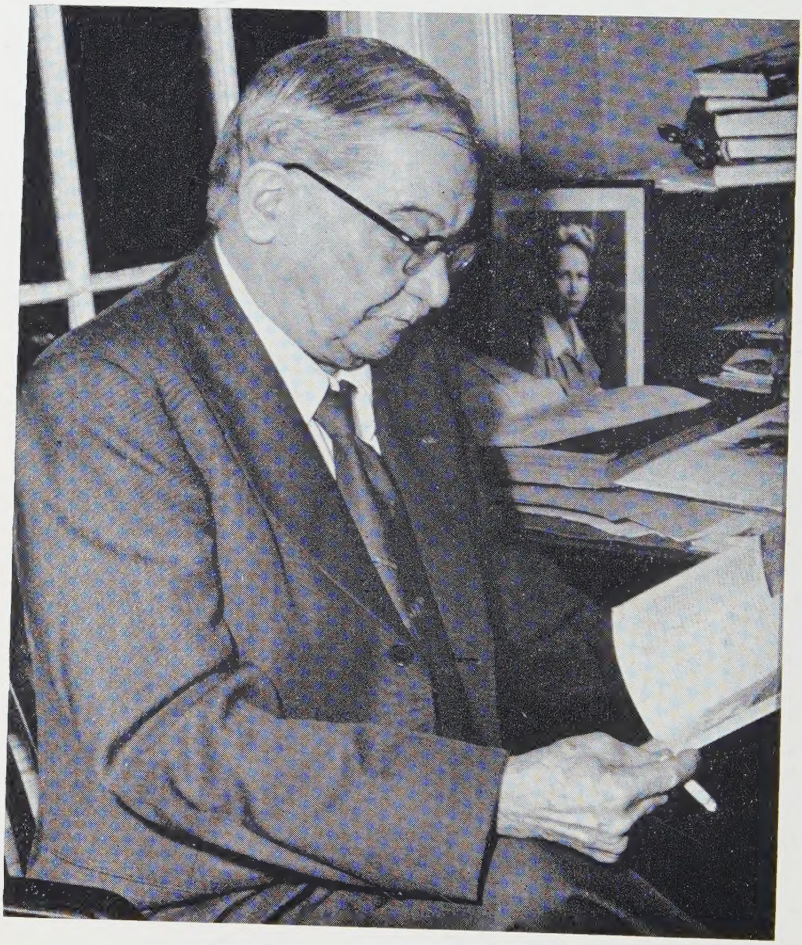

WILLIAM M. MANN
1886-1960

From a photograph taken in October, 1956. Courtesy of the Smithsonian Institution and Mrs. Lucile Q. Mann.

PSYCHE

Vol. 66 December, 1959 No. 4

WILLIAM M. MANN

"Each day I would stroll along the beach to a new stream and follow it to a new part of the forest, in a continual state of exultation over the abundant and interesting specimens."

ANT HILL ODYSSEY

The intense enthusiasm with which William Mann undertook the exploration of remote insect faunas was the dominant note in his unusual and distinguished scientific career. As a young man embarking on a series of extensive collecting trips to Brazil, Mexico, the West Indies, the Middle East, the South Pacific, and other parts of the world, he openly sought personal adventure as a major reward of scientific endeavor. The "Ant Hill Odyssey", as he later signified it in the title of his autobiography, was never allowed to stagnate in the physical confinement and routine that sometimes make scholarly enterprise falsely seem less than a great adventure. This spirit he was able to transmit to younger entomologists, and it was responsible for the beginning of the career of more than one young field biologist.

There would be little gain in attempting to recall here the events of Mann's crowded life already told so vividly in his autobiography. It may be noted that most of his entomological field work was conducted while he was a graduate student, and then a Sheldon Travelling Fellow, at Harvard University during 1911-17. As a student he served as Secretary of the Cambridge Entomological Club and Assistant Editor of *Psyche*. In 1917 he received a joint appointment in the United States Department of Agriculture and National Museum. In 1925 he fulfilled a life-long dream to become a zoo director when he succeeded Alexander Wetmore as head of the National Zoological Park. His autobiographical account ends with his 1917 appointment, but in fact the entomological odyssey never ended. As director of the national zoo, Mann made several major expeditions abroad to collect living animals and passed up no opportunity to gather insects, especially his beloved ants and ant-guests, on the side. Those privileged to know him in his later years could still sense the full ex-

citement of this continuing adventure in his wondrous after-dinner anecdotes of field trips around the world. A common story has it that Mann's faculty sponsor at Harvard, William Morton Wheeler, was at first keenly disappointed when he abandoned a full-time career as entomologist for zoo-keeping but soon became completely reconciled by his former student's obvious genius in the latter role. At the National Zoological Park, Mann was enormously successful. He developed humane, new techniques in zoo culture and was responsible for the introduction of many new animals to zoo life. He was renowned for the wit and eloquence with which he sought, and successfully obtained, the congressional appropriations needed to expand his zoo. His unfailing hospitality was extended to persons from all walks of life, and he had many close friends and an army of warm personal admirers. "Small in stature, puckish, bright-eyed and almost formally unkempt, Dr. Mann possessed a gentle wit which he used sparingly in public — lest it be considered unseemly in a scientist of his acknowledged standing. . . He became a familiar figure to thousands of Zoo patrons who brought away with them the charming memory of intimate little chats he was never too busy to hold with the least of his visitors."* When he died in his Washington home on October 10, 1960, at the age of seventy-four, the Ant Hill Odyssey perhaps seemed to many of his friends no more than a remote chapter in a colorful past. Yet it should not be forgotten that his early work produced major contributions that have actually gained in value with the passage of time.

Mann's collections of ants and myrmecophiles, which are the most significant parts of his general collections, are divided chiefly between the Museum of Comparative Zoology and the U. S. National Museum. His entomological publications are based mostly on this material, a fact that gives them their exceptional value. Mann's collections, especially those of ants made in the West Indies and South Pacific, were unusually thorough. Few men have been able to write taxonomic papers on tropical insect faunas with such an intimate firsthand knowledge of the ecology and faunal relationships of his study material. As a result, his larger monographs have been little improved on by later work and will undoubtedly remain primary references for years to come. The following bibliography includes as complete a list of Mann's technical entomological publications as could be assembled at this time. References to his well-known popular article on ants in the National Geographic and to his autobiography are also included.

**The Washington Post,* October 11, 1960.

No attempt has been made to list his articles dealing with zoo culture, travel, and other popular topics.

E. O. Wilson

Entomological Publications of William M. Mann

1911

Notes on the guests of some Californian ants. Psyche, *18*(1):27-31.

On some northwestern ants and their guests. Psyche, *18*(3):102-109.

1912

A third collection of Mallophaga from Alaskan birds. Ent. News, *23*:12-17. (With V. L. Kellogg).

Mallophaga from islands off Lower California. Ent. News, *23*:56-65. (With V. L. Kellogg).

Parabiosis in Brazilian ants. Psyche, *19*(2):36-41.

Note on a guest of *Eciton hamatum* Fabr. Psyche, *19*(3):98-100.

List of Histeridae and Buprestidae (Stanford Expedition to Brazil, 1911). Psyche, *19*(4):118-121.

A protective adaptation in a Brazilian membracid. Psyche, *19*(5): 145-147.

Literature for 1911 on the behavior of ants and myrmecophiles. J. Animal Behavior, *2*(6): 400-420.

1913

Literature for 1912 on the behavior of ants and myrmecophiles. J. Animal Behavior, *3*(6):429-445.

Mallophaga from Brazilian birds. Psyche, *20*(1):15-23. (With J. H. Paine).

1914

Some myrmecophilous insects from Mexico. Psyche, *21*(5):172-184.

The ants of Haiti. Bull. Amer. Mus. Nat. Hist., *33*(1):1-61. (With W. M. Wheeler).

1915

A new form of a southern ant from Naushon Island, Massachusetts. Psyche, *22*(2):51.

A cursorial tick. Psyche, *22*(2):60.

Some myrmecophilous insects from Hayti. Psyche, *22*(5):161-166.

A gynandromorphous mutillid from Montana. Psyche, *22*(5):178-180.

1916

The ants of Brazil (Stanford Expedition to Brazil, 1911). Bull. Mus. Comp. Zool. Harv., *60*(11):399-490, 7 plates.

The ants of the Phillips Expedition to Palestine during 1914. Bull. Mus. Comp. Zool. Harv., *60*(5):167-174. (with W. M. Wheeler).

1918

Myrmecophilous insects from Cuba. Psyche, *25*(5):104-106.

1919

The ants of the British Solomon Islands. Bull. Mus. Comp. Zool. Harv., *63*(7):273-391, 2 plates.

1920

A proctotrypid inquiline with Formica exsectoides Forel (Hym.). Proc. Ent. Soc. Wash., *22*(3):59-60.

Ant guests from Fiji and the British Solomon Islands. Ann. Ent. Soc. Amer., *13*(1):60-69.

Additions to the ant fauna of the West Indies and Central America. Bull. Amer. Mus. Nat. Hist., *42*(8):403-439.

1921

The ants of the Fiji Islands. Bull. Mus. Comp. Zool. Harv., *64*(5):401-499.

A new genus of termite guest from Fiji. Psyche, *28*(2):54-56.

Three new myrmecophilous beetles. Proc. U. S. Nat. Mus., *59*: 547-552.

1922

Notes on a collection of West African myrmecophiles. Bull. Amer. Mus. Nat. Hist., *45*:623-630.

Ants from Honduras and Guatemala. Proc. U. S. Nat. Mus., *61*(13):1-54.

1923

New genera and species of termitophilous Coleoptera from northern South America. Zoologica, *3*(17): 323-366.

Two new ants from Bolivia. Psyche, *30*(1):13-18.

Two serphoid guests of Eciton (Hym.). Proc. Ent. Soc. Wash., *25*(9):181-182.

A singular habit of sawfly larvae. Psyche, *30*(1):9-13. (With W. M. Wheeler).

1924

Myrmecophiles from the Western United States and Lower California. Ann. Ent. Soc. Amer., *17*(1):87-95.

Notes on Cuban ants. Psyche, *31*(1):19-23.

1925

Ants collected by the University of Iowa Fiji-New Zealand Expedition. Iowa Studies in Natural History, *11*(4):5-6.

Guests of *Eciton hamatum* (Fabr.) collected by Professor W. M. Wheeler. Psyche, *32*(3):166-177.

New beetle guests of army ants. J. Wash. Acad. Sci., *15*(4):73-77.

1926

Some new Neotropical ants. Psyche, *33*(4-5):97-107.

Three new termitophilous beetles from British Guiana. Proc. Ent. Soc. Wash., *28*(7):151-155.

New Neotropical myrmecophiles. J. Wash. Acad. Sci., *16*(16):448-455.

1928

A new Microdon from Panama. Psyche, *35*(3):168-170.

1929

Notes on Cuban ants of the genus Macromischa (Hymenoptera: Formicidae). Proc. Ent. Soc. Wash., *31*(8):161-166.

1931

A new ant from Porto Rico. J. Wash. Acad. Sci., *21*(17):440-441.

1934

Stalking ants, savage and civilized. National Geographic Mag., *66*(2):171-192.

1935

Two new ants collected in quarantine. Psyche, *42*(1):35-37.

1948

Ant Hill Odyssey. Little, Brown. (Autobiography).

SOME NEW SYNONYMY IN THE HAEMOGAMASIDAE, LAELAPTIDAE AND DIPLOGYNIIDAE INDICATED BY AN EXAMINATION OF BANKS' TYPES OF MESOSTIGMATA (ACARINA)

By Donald E. Johnston
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University of Maryland

During the course of a study of certain of the Banks mite types in the collection of the Museum of Comparative Zoology at Harvard College some cases of obvious synonymy were found. Two of these cases sink Banks' names; the remainder result in the establishment of his names as senior synonyms. In addition to those of Banks, the types of Ewing's, Furman's and Hicks' species (all in U.S. National Museum) were examined in connection with this work. I am grateful to Drs. H. W. Levi and W. L. Brown for arranging for me to study the Harvard collection and for their many kindnesses during my visit.

The following lectotype designations are not as precise as one would wish. The Banks types in the Museum of Comparative Zoology are not numbered and most names are represented by cotypes. All of the suspected and certain type slides are arranged alphabetically according to species and kept as a unit in the Arachnida collection of the Museum. Thus the lectotypes designated herein will be found labeled as such in their proper place in the alphabetical filing scheme. It may also be noted here that some of Banks' species (none of those treated herein) are represented by cotypes in both the MCZ and the Acarina collection of the U.S. National Museum. The same is true of Jacot's material which has been divided evenly between these museums.

Haemogamasidae

Haemogamasus longitarsus (Banks) Comb. Nov.

Laelaps longitarsus Banks, 1910. Proc. Ent. Soc. Wash. *12* (1):5. Ex mole's nest, Falls Church, Virginia. Lectotype in MCZ.

Haemogamasus barberi Ewing, 1925. Proc. Biol. Soc. Wash. *38*: 140. Ex nest of small mammal; Maryland shore of Potomac River, near Plummer Island. Type in U.S.N.M. NEW SYNONYMY.

Haemogamasus microti Ewing, 1925. Proc. Biol. Soc. Wash. *38*: 141. Ex *Microtus pennsylvanicus*, Bronxville, New York. Type in U.S.N.M. [=*barberi* according to Keegan, 1951:249]

Remarks: The type series of *Laelaps longitarsus* consisted of eight

specimens. These have been remounted individually and a female is here designated as lectotype (indicated on slide label).

Eulaelaps stabularis (Koch)

Gamasus stabularis Koch, 1836. Crust, Myr. Arachnid. Deutschlands, Fasc. 27, No. 1 Host unknown; Regensburg. Type unknown.

Laelaps pedalis Banks, 1909. Proc. Ent. Soc. Wash. *11* (3) :136. Ex chipmunk; Guelph, Ontario, Canada. Type in MCZ. NEW SYNONYMY.

Laelaps propheticus Banks, 1909. *Ibid*:136 Ex groundhog; Guelph, Ontario. Lectotype in MCZ. NEW SYNONYMY.

Remarks: The type slide of *L. propheticus* contained one female *E. stabularis* (here designated lectotype) and two *Haemolaelaps glasgowi* (Ewing). *Laelaps pedalis* is represented by a single female. The concept of *E. stabularis* with which Banks' names are synonymized is that of Strandtmann and Wharton (1958:127) and Bregatova (1956:100).

LAELAPTIDAE

Androlaelaps frontalis (Banks) Comb. Nov.

Gamasus frontalis Banks, 1910. Proc. Ent. Soc. Wash. *12* (3) :3. Ex *Perognathus*; Los Palmos, 3500 feet, Santa Rosa Mountains, California. Lectotype in MCZ.

Androlaelaps sinuosa Furman, 1954. Pan-Pacific Ent. *30* (2) :120. Ex *Pergognathus* sp., probably *fallax fallax*, at Pigeon Pass, Riverside County, California. Type in U.S.N.M. NEW SYNONYMY.

Remarks: The type slide bore four females and two males of this striking laelaptid. These have been remounted individually and a female is here designated lectotype (indicated on slide label). Banks' placement of this species in *Gamasus* (presumably because of the large size and calcarate femora of legs II) is undoubtedly the reason for its having been overlooked by workers in the Laelaptidae.

DIPLOGYNIIDAE

Neolobogynium americana (Banks) Comb. Nov.

Celaenopsis americana Banks, 1906. Proc. Ent. Soc. Wash. *7*: 137. Ex Histerid beetle (*Hololepta* sp.) at Indianapolis, Indiana. Lectotype in MCZ.

Neolobogynium laterisecta Hicks, 1957. Proc. Iowa Acad. Sci. *64*: 616. Host unknown; Ames, Iowa. Type in U.S.N.M. NEW SYNONYMY.

Remarks: Banks' type slide contained 18 adults of both sexes of this common mite associate of *Hololepta* (Histeridae). These have been remounted and a female is here designated lectotype (indicated on slide label).

References Cited

Bregatova, N. G. 1956. Gamasid Mites (Gamasoidea). Acad. Sci. U.S.S.R., Moskow. 247 pp. [in Russian.]

Keegan, H. L. 1951. The mites of the subfamily Haemogamasinae (Acari: Laelaptidae). *Proc. U. S. Nat. Mus. 101*:203-268.

Strandtmann, R. W. and G. W. Wharton. 1958. A manual of mesostigmatid mites parasitic on vertebrates. Contribution 4, Institute of Acarology, University of Maryland. i-xi+1-330+pls. 1-69.

ADDITIONS TO THE BIOECOLOGY OF THE NEW ENGLAND TINGIDAE AND PIESMIDAE (HETEROPTERA)[1]

By Norman S. Bailey
Bradford Junior College, Bradford, Mass.

Intermittent summer collecting during the past ten years has added to my collection a considerable number of noteworthy records. These include additional stations for species previously reported from only a few localities within a particular state and for some of the less well-known species in New England, new records for the occurrence of six species previously unreported from one or more of the New England states, and a few new host plant records.

This is the first of a series of papers now in progress which will supplement my studies of the Tingidae of New England (1951). For ease of reference, therefore, it follows the pattern of that study in the sequence of genera and of species. (Bailey, 1951, page 5). All collections were made by the author unless otherwise specified.

Family Piesmidae

Piesma cinerea (Say)

Shelton, Connecticut, August 2, 1951; Alna, Maine, August 15, 1954 and August 28, 1956. Found on a weedy *Amaranthus* (probably *retroflexus* L.) on each occasion.

In 1917 Professor Parshley reported this species from ocean drift at Beach Bluff, Massachusetts, and stated, "Not found heretofore north of Rhode Island". Since then it has become well-known from this state. The records from east-central Maine extend its range appreciably. Alna is a small town adjoining Wiscasset in the Sheepscot River Valley about fifty miles east-northeast of Portland.

Since published records for Connecticut are few, note is made of the Shelton collection.

Family Tingidae

Leptoypha mutica (Say)

Windham, New Hampshire, August 11, 1958.

A large collection of adults, many teneral, a few nymphs, and some exuviae was made from suppressed ash *(Fraxinus)* and ash suckers

[1]Acknowledgement is hereby gratefully made of a Sigma Xi—RESA Research Fund grant and Grant No. G5477 from the National Science Foundation, which make these studies possible.

growing on a dry, rocky hillside in a stand of young mixed hardwoods. This is, I believe, the third New Hampshire record for this small lace bug.

Galeatus peckhami (Ashmead)

Katahdin Trail, Maine, August 14, 1959; East Madison, New Hampshire, July 25, 1958.

Extended search was finally rewarded by these two collections from roadside asters (*Aster macrophyllus* L.) growing on dry, sunny banks. Though this host plant is common in northern New England, frequent search has provided only these two records. *Corythucha marmorata* (Uhler) is more commonly found on this aster.

Gargaphia tiliae (Walsh)

New Milford, Connecticut, August 2, 1951; Alna, Maine, August 29, 1956; Carroll, Maine, August 14, 1959; Petersham, Massachusetts, July 17, and 18, 1951; Conway, New Hampshire, July 25, 1958; Eaton, New Hampshire, July 25, 1958.

In general this arboreal species may be found on its host plant *Tilia*. Since few records have been published, those noted will extend our knowledge of its distribution. All the collections were made from *Tilia*.

Corythaica bellula Bueno

Alna, Maine, August 2, 1953, August 28, 1956, and September 9, 1958; Cedar Grove, Maine, July 11, 1953; Petersham (Harvard Forest), Massachusetts, July 16 and 17, 1951; Conway, New Hampshire, July 25, 1958 (sweeping); Eaton, New Hampshire, July 25, 1958.

Each collection was made by hand from *Panicum*, except in the instance noted. The Alna station was a wood road through a mature stand of *Pinus strobus* L. where the shade was almost constant but not intense and at a point where the road was beginning to rise at the base of a fairly sharp slope. This species was also seen, but not collected, on July 11, 1953, on *Panicum* growing on a little used, open drive within a stone's throw of the shore at Medomak, Maine. The Cedar Grove collection was from *Panicum* growing on a dry bluff overlooking the Kennebec River. These are the first Maine records.

In Bradford, Massachusetts, six collections of *C. bellula* Bueno were made from *Panicum* by hand and two by sweeping in 1957. Most of these were taken from an area of less than four square yards under a small red maple (*Acer rubrum* L.) where the *Panicum* was prominent and the total vegetation too sparse to cover the hard-packed

soil. These eight collections yielded 14 females, 4 males, and 8 nymphs. In 1958, six collections in the same area gave 6 females, 10 males, and 14 nymphs. The first specimens were taken on June 9th in 1957 and the last for the season on September 7th in 1958. Nymphs were taken as early as June 12th and as late as August 31st. Teneral adults occurred from as early as June 22nd until as late as August 17th. These data confirm the opinion that *C. bellula* Bueno should be found throughout New England in areas ecologically suitable.

Stephanitis globulifera (Matsumura)

West Hartford, Connecticut, August 25, 1958. They were abundant on *Pieris japonica* (Thunberg) Don used as foundation plants in front of a fairly new house in a recent development. This species first reported from North America in 1950 (Bailey) is apparently well-established in Connecticut, but I have yet to collect it elsewhere.

Stephanitis pyrioides (Scott)

West Newbury (Cherry Hill), Massachusetts, August 20, 1958. Nymphs and adults were found on young stock of several deciduous azalea species and hybrids growing in a lath house.

Stephanitis rhododendri Horvath

Petersham (Harvard Forest), Massachusetts, July 17 and 18, 1951.

The first collection was made from *Kalmia latifolia* L., a frequent host. The next day a few were found on *K. angustifolia* L. Although this is a very common shrub in eastern Massachusetts and Maine and, although it is on record as a host for this lace bug, this is my only collection from lambkill.

Corythucha bellula Gibson

Katahdin Trail, Maine, August 14, 1959; Gorham, New Hampshire, July 21, 1958.

This is the first record of the species from New Hampshire where it was found on roadside *Corylus*. Note below that *C. coryli* O. and D. also occurs in this state. The ecology of these two species in their contact zone should be a fruitful study since both utilize the same host. The Maine collection noted is a large one of particular interest since they were all taken from *Salix*.

Corythucha caryae Bailey

Scituate, Rhode Island, September 23, 1958.

This interesting range extension of a species previously collected only from a relatively limited area in eastern New Hampshire and

Massachusetts was the outstanding result of a one-day collecting trip into Rhode Island. They were found on *Carya* on the edge of a wooded area beside Route 14 and near the reservoir.

Corythucha coryli O. and D.

Monroe, Connecticut, August 2, 1951; Shelton, Connecticut, August 27, 1958; Epping, New Hampshire, September 20, 1958; Diamond Hill State Park, Rhode Island, September 23, 1958.

My collections now extend the range of this species into three more of the New England states for which there have been no published records. They were all taken from *Corylus* growing along the roadside.

Corythucha cydoniae (Fitch)

Newcastle, Maine, August 7, 1953; Haverhill (Ward Hill), Massachusetts, July 27, 1957 and August 23, 1960; Diamond Hill State Park, Rhode Island, September, 23, 1958.

This species can now be added to the faunal lists of two more New England states. Since it infests shrubs and small trees of several rosaceous genera that are widely distributed in the Northeast, the single reported occurrence north of Massachusetts suggested a wider distribution and also raised the question of limiting ecological factors. The wider range is now established but the ecological conditions controlling it surely deserve investigation. I have collected rather widely and, in a few areas, intensively in Maine with only the record cited above for this species. There it was feeding on native *Crataegus* in large numbers.

The single Rhode Island record, on the contrary, probably indicates lack of local interest in Tingids.

The Massachusetts records are given to report another host for *C. cydoniae*. *Cotoneaster hupehensis* Rehder and Wilson, used in a permanent shrub border in a local nursery was found to be heavily infested. About twenty yards away is a large clump of tall *Amelanchier*, also a part of the landscape arrangement, similarly infested. The lace bugs were breeding on both hosts.

The eighth edition of *Gray's Manual of Botany* (Fernald, 1950) considers *Pyracantha coccinea* Roemer (a previously reported host) a synonym for *Cotoneaster pyracantha* (L.) Spach while the 1949 revised edition of the *Manual of Cultivated Plants* (L.H. Bailey) maintains the distinctness of the genus *Pyracantha*. This leaves me with a question for the plant taxonomists to decide. If not another genus, we at least note another rosaceous species as a host for *C.*

cydoniae which thrives on many native and cultivated forms in this plant family.

Corythucha marmorata (Uhler)

Bradford, Massachusetts, July 6, 1957; Haverhill (Ward Hill), Massachusetts, July 27, 1957.

This species ranges throughout North America. In New England it feeds exclusively on a diversity of herbaceous composites. Apparently one of America's most successful Tingids in terms both of its wide distribution and of its local abundance, it is the only species of the fifteen in the genus occurring in New England that is neither arboreal nor thamnophilous. Its catholic preference for ubiquitous composites undoubtedly accounts in no small measure for its success.

Consequently, it was not surprising to find it thriving on two species previously unlisted. The Bradford observation was made on *Rudbeckia serotina* Nuttall, the common Black-eyed Susan or Yellow Daisy. On Ward Hill they were found on the cultivated Globe Thistle, *Echinops sphaerocephalus* L.

Corythucha mollicula O. and D.

Monroe, Connecticut, August 2, 1951; Newtown, Connecticut, August 2, 1951; Aurora, Maine (collected by Dr. A. G. Humes), July 13, 1950; Rockport, Maine, September 10, 1958; Sheepscot, Maine, August 6, 1953; Petersham (Harvard Forest), Massachusetts, July 18, 1951; Diamond Hill State Park, Rhode Island, September 23, 1958.

Probably again because of lack of collector interest, few records have been published for this species. Therefore, these, all from *Salix*, are cited.

Corythucha pruni O. and D.

Brookfield, Connecticut, August 2, 1951; Monroe, Connecticut, August 2, 1951; Shelton, Connecticut, August 27, 1958; Mattatuck, Connecticut, August 28, 1958; Alna, Maine, August 28, 1956 and September 9, 1958; Cedar Grove, Maine, September 15, 1957 and May 28, 1959; Dresden, Maine, June 22, 1957; Mexico, Maine (collected by Mr. J. J. B. Anderson), September 7, 1959; Newcastle, Maine, August 7, 1953; South Bristol, Maine, August 24, 1956; South Cushing, Maine, September 10, 1958; Epping, New Hampshire, September 20, 1958; Diamond Hill State Park, Rhode Island, September 23, 1958; Waterman, Rhode Island, September 23, 1958.

The Maine records cited establish the frequent occurrence of this species in the central coastal region and in other parts of that state. Another locality is added to the few published New Hampshire records. Rhode Island and Connecticut stations are given for the first time.

Of particular interest is the fact that the specimens from the two southernmost New England states suggest that typical *Corythucha pruni* O. and D. and typical *C. associata* O. and D. may represent extreme forms which have differentiated in the recent past from a common population. The latter has not yet been collected in Massachusetts nor further north. Until now, *C. pruni* had not been reported from southern New England. Both species restrict their feeding entirely to *Prunus serotina* Ehrhart. The collections noted above were all from this host. Two collections made in Connecticut in 1951 aroused my curiosity. In both, specimens of the two species were found on the same host plants. On recent critical examination of this material, I found that the Brookfield collections consisted of 26 specimens. Three of these were, on basis of hood size and form, definitely *C. pruni* (2 males and a female), 22 were *C. associata,* and one was questionably *C. associata* because the top of the hood was missing. Among the *associata* forms there was some variation in the height and width of the hood. The Monroe collection made the same day consisted of 38 that were surely *C. pruni* and a single female of *C. associata.* More recently a collection from Mattatuck produced 9 males of *C. pruni* and one female of *C. associata.* In Shelton one *C. pruni* male was found on a *Prunus* and another host plant in that town yielded 100 adults of *C. associata.*

Close study of these two species in Connecticut should answer some important questions. Except for the marked differences in their hood forms and, more significantly, the claspers of the males, they are very similar. In size and coloration they are almost identical. Frequent collections in several localities in this contact zone throughout one or two seasons would give valuable population information and specimens for careful comparison of structural details.

As previously mentioned, a similar situation involving the species *C. bellula* Gibson and *C. coryli* O. and D. whose primary host is *Corylus* may exist from central Maine and New Hampshire westward. Again we find two species of similar size with minor morphological distinctions. Similarly intriguing is the relationship between our two New England species whose host is commonly *Alnus.* Here, however, there are greater differences in size in addition to the

differences in structural details between the two and, consequently, their kinship is possibly more remote.

Corythucha ulmi O. and D.

Brookfield, Connecticut, August 2, 1951. Published Connecticut records are few. In my experience, this species is only rarely found even where elms are common.

Literature Cited

Bailey, L. H., 1949. *Manual of Cultivated Plants.* Macmillan, New York.

Bailey, Norman S., 1950. An Asiatic Tingid New to North America. *Psyche,* 57:143-145.

1951. The Tingoidea of New England and Their Biology. *Entomologica Americana,* 31 (n.s.) :1-140.

Fernald, M. L., 1950. Gray's Manual of Botany (Eighth Edition). American Book Company, Boston.

Parshley, H. M., 1917 a. Insects in Ocean Drift. *Canadian Entomologist,* 49 (2) :45-48.

1917 b. Fauna of New England, 14. List of the Hemiptera-Heteroptera. *Boston Society of Natural History, Occasional Papers,* 7:1-125.

GLANDULAR SOURCES AND SPECIFICITY OF SOME CHEMICAL RELEASERS OF SOCIAL BEHAVIOR IN DOLICHODERINE ANTS[1]

By Edward O. Wilson[2] and Mario Pavan[3]

Introduction

Species of the ant subfamily Dolichoderinae are excellent subjects for the experimental analysis of chemical communication. The group is advanced evolutionarily, and large, complex societies are the rule. During foraging, workers of many species form long, conspicuous columns tightly bound to persistent odor trails. When disturbed they void volatile secretions that seem likely to function, at least in part, as olfactory releasers of alarm behavior. Furthermore, the dolichoderines have recently been the object of extensive biochemical research by Pavan, Cavill and their associates (cf. Pavan, 1950; Pavan and Ronchetti, 1955; Pavan and Trave, 1958; Cavill, Ford, and Locksley, 1956; Cavill and Locksley, 1957). Several terpenoids including the previously unknown iridomyrmecin, iso-iridomyrmecin, and iridodial, have been identified as components of the anal gland secretion of various species. The availability of these substances in purified form has made possible for the first time the precise behavioral assay of natural secretory products in ants.

Trail Substances

Applying the artificial trail technique used earlier by one of us (Wilson, 1959) in studies of the myrmicine *Solenopsis saevissima*, an attempt was made to determine the glandular source of the trail substance in workers of *Iridomyrmex humilis* Mayr. Groups of workers from laboratory colonies (grown from stocks originating from Baton Rouge, Louisiana) were attracted to drops of 1 M sucrose solution, about 6 mm in diameter, on glass feeding tables. Selected body parts of freshly killed workers were made into artificial trails directed at the feeding workers. The number of workers following the trails beyond the trail midpoint, i.e., 15 cm. from the sucrose bait, were recorded. When positive responses were obtained, the duration of biological activity was timed to the nearest half-minute. Preliminary experiments showed that the trail substance is limited to the abdomen,

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smears from other body parts proving consistently inactive. This result was not unexpected, since *humilis* workers can be clearly seen to drag the posterior portion of the abdomen over the ground while in the act of laying trails.

Five organs in the abdomen are capable of emptying glandular secretions to the outside: (1) the hind-gut; (2) the paired "true" poison glands, with a large reservoir, the poison vesicle; (3) Dufour's gland (also called the accessory gland); (4) the anal glands, opening just above the anus; (5) the glandular "ventral organ" recently discovered by Pavan (1955). In a series of experiments, the five organs were dissected out of freshly killed workers, washed in insect Ringer's solution, and bioassayed with artificial trail tests. The results, summarized in table 1, show that the bulk, and perhaps the entirety, of the trail substance resides in the ventral organ. The occasional weak

TABLE 1. Results of artificial trail assay of selected abdominal organs of *Iridomyrmex humilis* workers.

Organ	Number of tests	Number of positive responses*	Number of workers responding: range (with mean)	Duration of responses in minutes: range (with mean)
hind gut	6	0	0-2 (M<1)	0-1/2 (M<1/2)
true poison glands, plus reservoir	6	0	0-2 (M<1)	0-1/2 (M<1/2)
Dufour's gland	8	2	0-30 (M=8)	0-4 (M=1)
anal gland	5	1	0-15 (M=6)	0-1 (M=1)
ventral organ	7	7	65-339 (M=134)	2-9 (M=5)

* Positive responses are defined, arbitrarily, as the crossing of the trail midpoint by 10 or more workers.

responses to the contents of the Dufour's and anal glands may not be biologically significant, i.e., may not indicate the presence of substances normally secreted into the trail, since responses of comparable magnitude have been obtained with pure methylheptenone, a substance not known to occur in *humilis* workers.

In a second series of experiments, the ventral organ and anal glands of *Iridomyrmex pruinosus* (Roger)[4] were assayed. As in *humilis*, the ventral organ smears caused strong trail following while re-

[4]Collected at Baton Rouge, Louisiana.

sponses to anal glands were negligible. Furthermore, artificial trails made with 2-heptenone, the anal gland secretion of *pruinosus* (M. S. Blum, *in litt.*), caused negligible responses.

In a third series of experiments, the hind-gut, poison apparatus, Dufour's gland, and ventral organ were assayed in a laboratory colony of the primitive dolichoderine *Monacis bispinosa* (Olivier).[4] The unusually restless and aggressive nature of the *Monacis* workers required the following modification in procedure. Straight trails 75 cm. in length were drawn down the middle of a clean glass plate. Three workers were then released, one at a time, and allowed to wander over the glass plate, crossing and re-crossing the trail. A positive response was recorded when the worker persistently followed the trail to its end. Of 18 workers thus exposed to trails made successively from 6 ventral organs, 17 gave positive responses. The responses of workers in triplicated control experiments using the other abdominal organs were all negative.

After the chief source of the odor trails in the three dolichoderine species had been located, bioassays were made across species, in order to determine the extent of species-specificity of the trail substances. As shown in table 2, each species appears to have a different substance.

TABLE 2. Intra- and interspecific trail-substance tests employed in the present study. Only intraspecific tests produced positive responses (+). The results of all interspecific tests employed were negative (—). Interspecific tests not attempted are indicated by a question mark.

Source	Recipient				
	Monacis bispinosa	*Liometopum occidentale*	*Iridomyrmex humilis*	*Iridomyrmex pruinosus*	*Tapinoma sessile*
M. bispinosa	+	?	—	?	—
L. occidentale	?	+	—	?	—
I. humilis	—	—	+	—	—
I. pruinosus	?	?	—	+	—
T. sessile	—	?	—	?	+

Further, the Dufour's glands and ventral organs of *Monacis bispinosa* were assayed with laboratory colonies of the myrmicine ants *Crematogaster lineolata* (Say), *Solenopsis geminata* (Fabr.), and *S. saevissima* (Fr. Smith). The ventral organ induced no detectable response in these species. The Dufour's gland caused no response in the *Crematogaster* but, quite unexpectedly, caused strong trail-following in *Solenopsis saevissima*! In fact, single *Monacis* glands consistently drew out approximately the same number of *S. saevissima* workers as single *saevissima* glands. It was also determined that a single *Monacis*

[4]Collected at Palmar, southern Costa Rica.

Dufour's gland caused a weaker response in *S. geminata*, well below the intensity caused by a *geminata* gland and approximately the same as that caused by a *saevissima* gland (see Wilson, 1960). These results are interpreted as indicating the chemical identity, or near-identity, of the *Monacis bispinosa* and *Solenopsis saevissima* Dufour's secretions. Curiously, the *Solenopsis* use the secretion as a trail substance, but the *Monacis* do not. The function of the secretion in *Monacis* remains unknown.

Some further comment is needed concerning the organ we are here referring to as the ventral organ. The gland was discovered in *Iridomyrmex humilis* by Pavan (1955) and described in greater detail by Pavan and Ronchetti (1955). It is a paddle-shaped organ resting on the ventral body wall just over abdominal sternite VI (sternite IV of gaster). It opens posteriorly via a neck-like constriction between the VI and VII abdominal sternites. The opening is fitted with an unusual beak-shaped deformation of the posterior border of sternite VI, a structure seemingly designed to guide the effluence of the gland contents. Until the present experimental work, the function of the gland remained unknown, although Pavan and his associates suggested that it produced either the trail substance or a secondary defensive secretion. Additional morphological studies by Miradoli Zatti and Pavan (1957) disclosed the presence of a closely similar gland in the primitive dolichoderine genera *Aneuretus* and *Leptomyrmex*. In the course of subsequent work we have noted its presence in *Monacis bispinosa* and *Hypoclinea doriae* Emery as well. The ventral organ appears to be peculiar to the Dolichoderinae and Aneuretinae and hence can serve as a valuable diagnostic character for these two closely allied groups. If it serves as the source of the trail substance in all of the dolichoderine tribes (and in the ancestral aneuretines), as the preliminary evidence suggests, it can be interpreted as a remarkable example of a "social organ" evolved *de novo* with the specific function of mediating worker communication.

Alarm Substances

When colonies of *Tapinoma sessile*, *Liometopum occidentale*, and *Monacis bispinosa* are disturbed by opening the nest, workers release considerable quantities of secretions from their anal glands which can be easily smelled by the human observer. When the anal glands are removed from freshly killed workers of these species and their contents released in the presence of groups of resting live workers, the latter are thrown instantly into a typical alarm frenzy, indistinguish-

able from that caused by direct mechanical disturbance. Other body parts tested in this manner do not induce the same reaction. Although the volatile components of the anal glands of each species produce a distinctly different smell to humans, there is evidently no species-specificity shown in the alarm response. Unlike the complete specificity shown in responses to trail substances, squashes of anal glands of each species produce approximately the same intensity of alarm curiosity in workers of the other two species as in its own. These results can be interpreted as indicating that either a common component exists in each of the anal secretions or else, as seems more likely, the secretions differ but the reactions are not species-specific.

In contrast, disturbed workers of *Iridomyrmex humilis* do not release quantities of volatile substances sufficient to be detected by the human observer. Moreover, they do not respond with more than mild excitement to single anal-gland squashes from sister workers or the other three dolichoderine species.

Pavan and Trave (1958) have shown that the volatile components of anal gland secretion of *Tapinoma nigerrimum* (Nylander) are methylheptenone ($C_8H_{14}O$) and propyl-isobutyl-ketone ($C_8H_{16}O$). Since our initial experiments suggested that the action of alarm substances is not species-specific, it was not surprising to find that small quantities of the two *nigerrimum* substances, manufactured synthetically and presented in separate tests, caused intense alarm behavior in *Tapinoma sessile*. No attempt has been made to map the full range of compounds that will induce the alarm frenzy in the dolichoderines that communicate alarm by anal secretions. However, the following preliminary study will show that not all volatile ant secretions have this effect. A simple olfactometer test designed to measure mass response in laboratory colonies of *Solenopsis saevissima* (cf. Wilson, 1960) was applied to a small (300-worker) colony of *Tapinoma sessile*. The tested compound was allowed to evaporate from a 15 mm^2 film into a nest inlet into which air was being gently drawn. The maximum increase, if any, of workers outside the nest was then measured during the ensuing five minutes. Each substance was tested three times. Tests were spaced at least two hours apart to reduce habituation, and substances were presented in irregular order to prevent special sequential effects. Formic acid, a common defensive abdominal secretion of formicine ants, caused either no visible response or very mild excitement in the nest, and increased the outside worker force by only 3-8. Concentrated Dufour's gland secretion of *Solenopsis saevissima*, which induced a mass exodus of *saevissima*

workers in similiar tests, caused in *Tapinoma sessile* either no visible effect or mild excitement in the nest, and increased the outside worker force from minus-1 to 9. A mixture of nepetalactone (oil of catnip) and oil of peppermint caused mild excitement in the nest and an exodus of 2 to 24 workers. Propyl-isobutyl-ketone caused mild to intense excitement in the nest and an exodus of 12 to 23 workers; many of the workers were in maximum intensity of excitement and ranged widely over the foraging table. Methylheptenone caused mild to intense excitement in the nest, and an exodus of 4 to 69 workers, many of which were maximally excited and ranged widely over the foraging table. In one trial using methylpeptonone, a queen, several callows, and other workers carrying brood also left the nest temporarily.

In two subsequent experiments, small *Tapinoma sessile* colonies were exposed in the manner just described to prolonged doses of methytheplenone. In both cases, excitement within the nest and individual worker exodus declined to about the normal level within 10 minutes. Shortly afterward, however, workers began mass movements along odor trails to secondary shelters away from the main nest. Within 90 minutes almost the entire colony had emigrated to the new nest sites, leaving behind only a few workers in the main nest.

Summary

In *Iridomyrmex humilis* Mayr, *I. pruinosus* (Roger), and *Monacis bispinosa* (Olivier), representing two genera phylogenetically far apart in the Dolichoderinae, the principal or exclusive source of the odor trail is the ventral organ, an exocrine gland opening behind abdominal sternite VI. Cross-species tests were made with the odor trails of these species and of *Liometopum occidentale* Emery and *Tapinoma sessile* Say. The trail-substances were found to be species-specific. The ventral organ is peculiar to the Dolichoderinae and the ancestral Aneuretinae, and it is interpreted as an example of a "social organ" that has been evolved *de novo* as part of the colonial communication system.

Volatile alarm substances are produced in the anal glands of each of the species except *Iridomyrmex humilis*. These releasers are not species-specific. The volatile anal secretions of *Tapinoma nigerrimum*, methylheptenone and propyl-isobutyl-ketone, when tested with workers of *Tapinoma* sessile, produced typical alarm behavior. Prolonged exposure induced colony emigration, which was then organized by the laying of odor trails.

References

Cavill, G. W. K., D. L. Ford, and H. D. Locksley. (1956). The chemistry of ants. I. Terpenoid constituents of some Australian Iridomyrmex species. Australian J. Chem., **9** (2): 288-293.

Cavill, G. W. K. and H. D. Locksley. (1957). The chemistry of ants. II. Structure and configuration of iridolactone (isoiridomyrmecin). Australian J. Chem., **10** (3): 352-358.

Miradoli Zatti, M. A. and M. Pavan. (1957). Studi sui Formicidae. III. Nuovi reperti dell'organo ventrale nei Dolichoderinae. Boll. Soc. Ent. Ital., **87** (5-6): 82-87.

Pavan, M. (1950). Potere Insetticida della iridomyrmecina e significato della sostanza vella biologia di *Iridomyrmex humilis* Mayr. La Ricerca Scientifica, **20** (12): 1853-1855.

(1955). Studi sui Formicidae. I. Contributo alla conoscenza degli organi gastrali dei Dolichoderinae. Natura, **46**: 135-145.

Pavan, M. and G. Ronchetti. (1955). Studi sulla morfologia esterna e anatomia interna dell'operaia di *Iridomyrmex humilis* Mayr e richerche chimiche e biologiche sulla iridomirmecina. Att. Soc. Ital. Sci. Nat., **94** (3-4): 379-477.

Pavan, M. and R. Trave. (1958). Études sur les Formicidae. IV. Sur le venin du Dolichoderide *Tapinoma nigerrimum* Nyl. Insectes Sociaux, **5** (3): 299-308.

Wilson, E. O. (1959). Source and possible nature of the odor trail of fire ants. Science, **129**: 643-644.

(1960). Chemical communication among workers of the fire ant *Solenopsis saevissima* (Fr. Smith). Animal Behaviour (in press).

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